Sensitivity of $Ru(bpy)_2dppz^{2+}$ Luminescence to DNA Defects

Mi Hee Lim, Hang Song, Eric D. Olmon, Elizabeth E. Dervan and Jacqueline K. Barton

Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, California 91125

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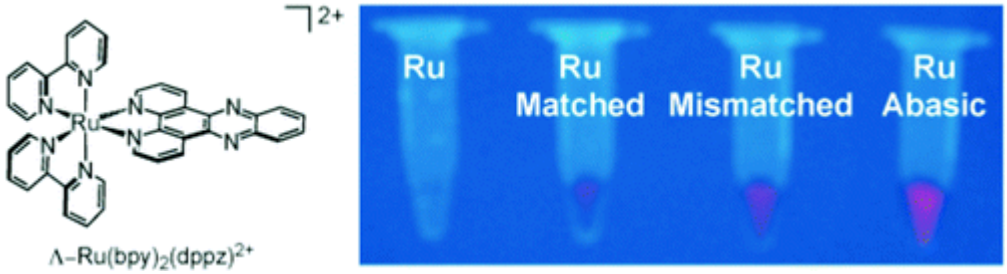
Abstract



The luminescent characteristics of $Ru(bpy)_2dppz^{2+}$ (dppz = dipyrido[3,2-*a*:2′,3′-*c*]phenazine), a DNA light switch, were investigated in the presence of oligonucleotides containing single base mismatches or an abasic site. In water, the ruthenium luminescence is quenched, but, bound to well matched duplex DNA, the Ru complex luminesces. Here we show that with DNAs containing a defect, *rac*-, Δ-, and Λ-$Ru(bpy)_2dppz^{2+}$ exhibit significant luminescent enhancements above that with well matched DNA. In the presence of a single base mismatch, large luminescent enhancements are evident for the Δ-Ru isomer; the Λ-isomer shows particularly high luminescence bound to an oligonucleotide containing an abasic site. Similar increases are not evident with two common DNA-binding organic fluorophores, ethidium bromide and TO-PRO-3. Titrations with hairpin oligonucleotides containing a variable mismatch site show correlation between the level of luminescent enhancement and the thermodynamic destabilization associated with the mismatch. This correlation is reminiscent of that found earlier for a bulky rhodium complex that binds mismatched DNA sites through metalloinsertion, where the complex binds the DNA from the minor groove side, ejecting the mismatched bases into the major groove. Differential quenching studies with minor and major groove quenchers and time-resolved emission studies support this metalloinsertion mode for the dppz complex at the defect site. Certainly these data underscore the utility of $Ru(bpy)_2dppz^{2+}$ as a sensitive luminescent reporter of DNA and its defects.

Full text (subscription may be required):
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